

REMARKS

Applicants have amended claims 1, 14 and 17 to define a feature which is apparent from an inspection of Figures 2 and 4 and which helps to distinguish over the applied art. In addition, claim 17 has been amended so that it is in a proper statutory class, under 35 USC 101. A typographical error in claim 16 has been corrected. Applicants have added claim 29 to provide them with the protection to which they are deemed entitled. Claim 29 ultimately depends on claim 14 and therefore is in the group of claims which have been withdrawn from consideration. Applicants are of the belief, as discussed infra, that all claims in the present application should be considered together and the restriction requirement is improper.

All claims, as amended, distinguish patentably over Chen et al., U.S. patent 5,807,789 in view of Tsuchiya et al., U.S. patent 5,716,534 and further view of Howald et al., WO 00/58992, by requiring, inter alia, the amount of AC power that is gradually changed on a pre-programmed basis and supplied to the plasma during processing of the workpiece to be while the power is in a steady-state condition subsequent to power startup and prior to the beginning of power shutdown.

In the Chen et al. reference there are three sequential steps, each involving a different etch process. The examiner has recognized the distinction between the claims of the present application and Chen et al. as being the requirement to gradually change, on a pre-programmed basis, the amount of AC power supplied to the plasma during processing of the workpiece.

During step one of Chen et al., oxide and nitride layers 34 and 32 are etched by supplying 800 watts to the plasma while setting the chamber pressure at 50 millitorr for eight seconds. During step two, the top of the trench in substrate 30 is initially opened by applying 700 watts to the plasma while setting the chamber pressure at 80 millitorr for eight seconds. During step three, the trench in substrate 30 is etched to the bottom with a rounding effect by supplying 650 watts to the plasma while setting the chamber pressure at 100 millitorr for 46 seconds. In other words, the power coupled to the plasma during each of steps one, two and three has a different constant value. Applicants attribute the rounding effect of step three to gradual changes in chamber pressure from the pressure at the end of step two to the pressure at the end of step three. It is well known that the pressure in the chamber cannot change instantaneously in response to

changes in pressure set points. In any event, the rounding effect is not caused by any change in the power supplied to the plasma *during* step three because there is no change in plasma power during step three. Because plasma power, in contrast to chamber pressure, changes instantaneously the plasma power throughout step three is constant at 650 watts.

Tsuchiya et al. discloses a plasma processing method wherein plasma generation is respectively started and stopped in accordance with the timing charts shown in Figures 30 and 31, according to a first embodiment, and in accordance with the timing charts shown in Figures 32 and 33, according to a second embodiment. In this regard, note column 12, lines 48, 66 and 67, as well as column 13, line 16. Column 12, lines 66 and 67 imply there is not significant plasma processing during the starting and stopping periods indicated by Figures 30-33 by stating "After predetermined etching is performed, plasma generation is ended..." Column 13, lines 4-8 indicate the power startup and shut down sequences are employed to stepwise decrease the dissociation count of the plasma to minimize damage to the workpiece due to charge-up damage to the wafer. Column 1, lines 42-45 indicate the first object of the method of the '534 patent is to suppress damage to a target object under low-pressure processing conditions. Hence, Tsuchiya et al. fails to disclose changing, on a pre-programmed basis, the amount of AC power supplied to the plasma during processing of the workpiece while the power is in a steady-state condition subsequent to power startup and prior to the beginning of power shutdown, as each of the claims requires.

Howald et al. also fails to disclose changing, on a pre-programmed basis, the amount of AC power supplied to the plasma during processing of the workpiece while the power is in a steady-state condition subsequent to power startup and prior to the beginning of power shutdown, as each of the claims requires.

Based on the foregoing, each of the independent claims is unobvious over the combination of Chen et al., Tsuchiya et al. and Howald et al.

Each of the dependent claims is patentable for the same reasons advanced for the independent claims.

In addition, each of claims 7, 15 and 19 defines an important feature of applicants' invention that is not disclosed nor made obvious by the combination of Chen et al., Tsuchiya et al. and Howald et al. In particular, each of claims 7, 15 and 19 requires a gradual transition to occur in the shape of material in the workpiece being processed in response to the gradual power change. Each of these claims now more particularly requires the gradual power change to occur during the gradual transition in the shape of the material. As pointed out previously, in Chen et al. the power remains constant during each of the three steps. Tsuchiya et al. implies there is no significant processing of the workpiece during the startup and shutdown intervals indicated by Figures 30-33. Howald et al. fails to disclose gradual transitions in the shape of material in the workpiece or gradual power changes.

Claims 8 and 20, as well as new claim 29, indicate the gradual power change of claims 7, 19 and 15, respectively, is such that the material is shaped to have a rounded corner in response to changes resulting from the gradual power change. Chen et al. is the only applied reference material to these claims because it is the only reference disclosing a rounded corner. However, as previously discussed, the Chen et al. rounded corner does not result from a gradual power change that occurs during the gradual transition in the shape and material. Instead, in Chen et al. the power remains constant as a rounded corner is being formed.

Dependent claims 12 and 13 respectively indicate the gradual power change of claim 7 (1) includes steps having power changes no greater than about several watts, such that the power remains at a constant value for no more than about one second and (2) that the power steps are a few milliwatts and remain at a constant power for about one millisecond. Each of claims 26-28 requires the gradual change to include steps having power changes in the range of a few milliwatts to several watts and to have durations in the range of about one millisecond to about one second. Applicants have found these particular parameters are very helpful in achieving the desired control for the shape of a feature formed on the workpiece.

The Examiner is again requested to reconsider the restriction requirement between claims 14-16, as well as newly added claim 29, which depends ultimately on claim 14, vis-a-viz the

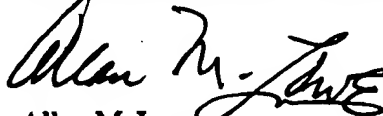
remaining claims. The subject matter of claims 14-16 and 29 is not independent and distinct from the remaining claims. The only difference between claims 14-16 and 29 and the remaining claims of the application is that claims 14-16 and 29 define a processor, while the remaining claims define a method of processing or a memory storing a computer program for controlling a computer for controlling processing. As pointed out on page 5 of the office action using a computer to automate a known process does not "impart nonobviousness to the invention." Since the limitations of claims 14-16 and 29 are essentially the same as those of the remaining claims, restriction between claims 14-16 and 29 and the remaining claims is incorrect.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance are respectfully requested and deemed in order.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

LOWE HAUPTMAN GILMAN & BERNER, LLP



Allan M. Lowe
Registration No. 19,641

1700 Diagonal Road, Suite 300
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: June 11, 2003
AML/gmj